

What is claimed is:

1. An exhaust emission control apparatus for an internal combustion engine comprising:

an NOx catalyst disposed in an exhaust passage of said internal combustion engine;

a temperature raising section for raising the temperature of said NOx catalyst; and

a nitrogen oxides reducing section for reducing an amount of nitrogen oxides occluded in said NOx catalyst before said temperature raising section is operated to raise the temperature of said NOx catalyst.

2. The exhaust emission control apparatus for an internal combustion engine as set forth in claim 1, wherein said nitrogen oxides reducing section comprises a reducing agent supplying section for supplying a reducing agent to said NOx catalyst.

3. The exhaust emission control apparatus for an internal combustion engine as set forth in claim 2, wherein said reducing agent supplying section supplies said reducing agent to said NOx catalyst by performing the sub-injection of fuel on at least one of an intake stroke, an expansion stroke and an exhaust stroke of said internal combustion engine.

4. The exhaust emission control apparatus for an internal combustion engine as set forth in claim 2, wherein said reducing agent supplying section supplies said reducing agent to said NOx catalyst by adding said reducing agent to an exhaust from a reducing agent addition valve disposed on said exhaust passage of said internal combustion engine.

5. The exhaust emission control apparatus for an internal combustion engine as set forth in claim 1, further comprising an estimating section for estimating the amount of nitrogen oxides occluded in said NOx catalyst,

wherein when the amount of nitrogen oxides estimated by said estimating section is less than a predetermined amount, said nitrogen oxides reducing section does not reduce the amount of said nitrogen oxides occluded in said NOx catalyst.

6. The exhaust emission control apparatus for an internal combustion

engine as set forth in claim 1, wherein said temperature raising section raises the temperature of said NOx catalyst when poisoning of said NOx catalyst due to sulfur oxide is removed.

7. The exhaust emission control apparatus for an internal combustion engine as set forth in claim 1, wherein said NOx catalyst comprises:

an NOx occlusive agent being operable to occlude said nitrogen oxides in an exhaust when the air fuel ratio of the exhaust flowing into the NOx catalyst is lean, and discharge the occluded nitrogen oxides when the oxygen concentration of the exhaust flowing into the NOx catalyst is reduced ; and

a particulate filter for collecting particulate matter in said exhaust;

wherein said temperature raising section raises the temperature of said NOx catalyst when said particulate matter collected by said particulate filter is removed.

8. An exhaust emission control apparatus for an internal combustion engine comprising:

an NOx catalyst disposed in an exhaust passage of said internal combustion engine;

a temperature raising section for raising the temperature of said NOx catalyst;

a first reducing agent supplying section for supplying a reducing agent to said NOx catalyst when an amount of nitrogen oxides occluded in said NOx catalyst becomes more than or equal to a predetermined amount; and

a second reducing agent supplying section for supplying an amount of said reducing agent more than that supplied by said first reducing agent supplying section to said NOx catalyst before said temperature raising section is operated to raise the temperature of said NOx catalyst.

9. The exhaust emission control apparatus for an internal combustion engine as set forth in claim 8, wherein said second reducing agent supplying section increases the amount of reducing agent to be supplied in accordance with the increasing amount of nitrogen oxides occluded in said NOx catalyst.

10. The exhaust emission control apparatus for an internal combustion engine as set forth in claim 8, wherein said temperature raising section raises

the temperature of said NOx catalyst when poisoning of said NOx catalyst due to sulfur oxide is removed.

11. The exhaust emission control apparatus for an internal combustion engine as set forth in claim 8, wherein said NOx catalyst comprises:

5 an NOx occlusive agent being operable to occlude said nitrogen oxides in an exhaust when the air fuel ratio of the exhaust flowing into the NOx catalyst is lean, and discharge the occluded nitrogen oxides when the oxygen concentration of the exhaust flowing into the NOx catalyst is reduced ; and

a particulate filter for collecting particulate matter in said exhaust;

10 wherein said temperature raising section raises the temperature of said NOx catalyst when said particulate matter collected by said particulate filter is removed.

12. An exhaust emission control apparatus for an internal combustion engine comprising:

15 an NOx catalyst disposed in an exhaust passage of said internal combustion engine;

a temperature raising section for raising the temperature of said NOx catalyst;

20 an estimating section for estimating an amount of nitrogen oxides occluded in said NOx catalyst; and

an operation control section adapted to permit an operation of said temperature raising section when the amount of nitrogen oxides estimated by said estimating section is less than a predetermined amount.

13. The exhaust emission control apparatus for an internal combustion engine as set forth in claim 12, wherein said temperature raising section raises the temperature of said NOx catalyst when poisoning of said NOx catalyst due to sulfur oxide is removed.

14. The exhaust emission control apparatus for an internal combustion engine as set forth in claim 12, wherein said NOx catalyst comprises:

30 an NOx occlusive agent being operable to occlude said nitrogen oxides in an exhaust when the air fuel ratio of the exhaust flowing into the NOx catalyst is lean, and discharge the occluded nitrogen oxides when the oxygen

concentration of the exhaust flowing into the NOx catalyst is reduced ; and
a particulate filter for collecting particulate matter in said exhaust;
wherein said temperature raising section raises the temperature of said
NOx catalyst when said particulate matter collected by said particulate filter is
5 removed.

15. An exhaust emission control method for an internal combustion engine
comprising:

a temperature raising step for raising the temperature of an NOx
catalyst disposed in an exhaust passage of said internal combustion engine;
10 and

an nitrogen oxides reducing step for reducing an amount of nitrogen
oxides occluded in said NOx catalyst before said temperature raising step.

16. The exhaust emission control method for an internal combustion
engine as set forth in claim 15, wherein in said nitrogen oxides reducing step,
15 the amount of nitrogen oxides occluded in said NOx catalyst is reduced by
supplying a reducing agent to said NOx catalyst.

17. The exhaust emission control method for an internal combustion
engine as set forth in claim 15, further comprising an estimating step for
estimating the amount of nitrogen oxides occluded in said NOx catalyst before
20 said nitrogen oxides reducing step,

wherein said nitrogen oxides reducing step is not performed when the
amount of nitrogen oxides estimated in said estimating step is less than a
predetermined amount.

18. An exhaust emission control method for an internal combustion engine
25 comprising:

a temperature raising step for raising the temperature of an NOx
catalyst disposed in an exhaust passage of said internal combustion engine;
and

a nitrogen oxides reducing step for reducing an amount of nitrogen
30 oxides occluded in said NOx catalyst by supplying a reducing agent to said
NOx catalyst when the amount of nitrogen oxides occluded in said NOx
catalyst becomes more than or equal to a predetermined amount;

wherein an amount of reducing agent supplied to said NOx catalyst is increased in said nitrogen oxides reducing step before said temperature raising step.

19. The exhaust emission control method for an internal combustion engine as set forth in claim 18, wherein the amount of reducing agent is increased in accordance with the increasing amount of said nitrogen oxides occluded in said NOx catalyst in said nitrogen oxides reducing step before said temperature raising step.

20. An exhaust emission control method for an internal combustion engine comprising:

an estimating step for estimating an amount of nitrogen oxides occluded in an NOx catalyst disposed in an exhaust passage of said internal combustion engine; and

a temperature raising step for raising the temperature of said NOx catalyst on the condition that the amount of nitrogen oxides estimated in said estimating step is less than a predetermined amount.